Dear UCITE Nord Grant Committee Members:

Scientific computing solving problems, which arise throughout the natural sciences, social sciences, engineering, medicine, and business, becomes powerful with the development of computer power. Educating the next-generation of leaders in numerical methods is thus an important goal. Numerical Differential Equation (Math432) is a core course for both graduate and undergraduate programs in the Department of Mathematics, Applied Mathematics and Statistics. It is actually a popular course for the entire university. In each spring semester I taught Math432, at least five PhD students outside our program took this course. For this course, students are not only understanding the mathematical concepts, but also required to engage in hand-on programming and participate the analysis. The original design of this course involves lectures and homework problems. The material is based on the classical examples in the adopted textbook. This approach works well for students understanding the important concepts. However, there is a main challenge we face to stimulate active learning and connect course materials to research projects.

Since Math432 prepares applied math graduate students for their qualify exam, the classical textbook –Finite Difference Methods for Ordinary and Partial Differential Equations by Randall J. LeVeque – is adopted for many years. Solutions for exercises in the textbook can been found from different online resources and answer keys for circulated homework problems have been posted for previous students. To motivate active learning, new examples, refreshed exercise questions, and cutting-edge research problems would be essential to be incorporated in the original design of this course.

This proposal is intended to meet these challenges by pedagogically redesigning and enhancing the course in innovation and making effort toward improving the level of engagement and active learning within our current course Math432. I will apply research results to this course so as to improve student's learning experiences while at the same time retaining those essential aspects of the course that remain effective for achieving our overall pedagogical goals.

Additionally, fluid mechanics, as one of most important branches in applied mathematics, has not been introduced in any of the existing courses in the department yet. By redesigning the course, fluid mechanics along with life science applications will be introduced to students. Exploring mathematical and computational methods in the science and engineering applications will stimulate more students to work in these important areas. This will also increase the chance to recruit graduate students working with me and my other junior colleagues who share the similar research interests. One undergraduate assistant will be hired to learn flow facilities (wind tunnel and water tunnel) and equipment (Particle image velocimetry, high-speed camera, etc) at Dr. Wei Zhang's lab at Cleveland State University, and collect experimental

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data for this course.

New examples will require students to be involved and engaged, and course projects require them to collaborate with each other. To successfully train students with peer interactions which support them to learn, strategical designing is needed to careful select the examples and construct course projects from the applicable topics. Eventually, this course will be carefully redesigned as a combination of traditional lectures with modern examples, and pioneer research problems. To prepare students arriving at different levels, I will maintain documents or online page for prerequisites for students. Moreover, writing scientific reports and presentation are crucial for the students to communicate with the broad scientific community. I will train students with technologies commonly used in the field of Mathematics.

Specifically, I will accomplish the following main goals. The **first** goal is to update homework problems and create new projects that combine cutting-edge research projects with in-class methods. I will adapt the course that is more interactive, engaging, and entertaining than a typical lecture and more informative and educational than the original course. Experimental data and examples will be collected and provided as supplement materials. The **second** goal is to create documents provided to students and share with colleagues interested in this course. Using slides and videos throughout teaching at different levels has showed with great success. Especially, I seek funding to support my effort to establish a list of educational videos and online tutorials. Last but not least, I will search and identify existing third-party resources that would be well-matched for assignments to major conceptual topics listed week-by-week for the semester. I will establish an initial collection of resources, including reference books, in print, online material, and tutorials.

The Nord grant of total $5188.70 is requested to fund the purchase of supplies (book, software and device), summer support for an undergraduate assistant, and a conference trip. The travel fund is requested to support me to the annual APS DFD meeting. This annual meeting will allow me to present my work and participate discussion for fluids education with peers. Thus, it will enhance my current pedagogical skills to redesign the course I teach in almost every spring semester.

In summary, I am highly committed to this exciting project. Other department members appeared in promoting this change. I greatly appreciate the Nord Grant opportunity and believe that this grant will provide substantial support to enhance the importance of Math 432 or even Math330 (undergraduate course).

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Professor and **Chair**

A total **$5188.70** is requested. The budget will be used to buy supplies, support one undergraduate assistant, and cover a conference trip.

- Books related to numerical methods and fluid mechanics will be purchased with a budget $200.

- Financial support ($3500) of one summer undergraduate assistant, who will work with the faculty supervisor to develop experimental photos or video clips for the topics .

- A budget of $1488.70 is requested to support a domestic trip to 71st Annual Meeting of the APS Division of Fluid Dynamics, November 18-20, 2018, Atlanta, GA.
  The detailed budget for the conference trip is in the the following table.

Budget

71st Annual Meeting of the APS Division of Fluid Dynamics,
November 18-20, 2018,
Atlanta, GA.

Description			Total
APS membership			159.00
conference registration			485.00
Hotel (2 nights)	group rate $150 /night +16.9% tax		350.70
flights			200.00
Ground transportation	Home to/from airport; airport to/from hotel		150.00
per diem from 3 days	day rate: $48		144.00

Total for travel	1,488.70

Note :   nonmember registation fee is $740.